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AUTHOR Fischer, Susan D.; Mayberry, Rachel
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ABSTRACT

This discussion is based on the results of an earlier experiment in which four groups of deaf subjects, ranging in age of first exposure to signing from birth to over eighteen, were given lists of sentences in American Sign Language to shadow and recall immediately after presentation. It was found that in terms of overall accuracy, early learners outperformed late learners, that sentences were recalled and shadowed more accurately than scrambled sentences, and that shadowing was more accurate than immediate recall. This paper concentrates on an analysis of the errors in that experiment, since patterns of errors can give more clues as to how people process language. Three main categories of errors were classified--deletion, addition, and substitution. Addition and substitution errors were further classified into whether they were random, repetitions, semantic, phonological, or simultaneously semantic and phonological. Groups I (native) and II (5-7) pattern very similarly in both the number of errors and in the proportion of errors in the various categories. Those in group IV (18 plus) seem lost while those in group III (13-15) pattern similarly. Sentencehood has an effect on the performance of only the first two groups. The specific task leads to differential error patterns across the same groupings. (Author/JK)

# Levels of Sign Language Processing:

## Qualitative Measures*

Susan D. Fischer & Rachel Mayberry,
NTID/RIT Northwestern U.

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1. Introduction

We are basically interested in measuring the relationship between linguistic knowledge and linguistic processing; in particular, we are interested in the ways in which different sorts of psycholinguistic processing reflect or are affected by linguistic competence; in this case that linguistic competence relates to ASL, and that processing is through a visual-gestural modality; however, there should be some relationship between what we find for signed languages and what is found for spoken language. To this end, therefore, we performed the experiment described in the paper just preceding. To summarize, four groups of deaf subjects, ranging in age of first exposure to signing from birth to over 18 were given lists of ASL sentences to shadow and to recall immediately after presentation. What we found in terms of overall accuracy was that early learners outperformed late learners, that sentences were recalled and shadowed more accurately than scrambled sentences, and that shadowing was more accurate than immediate recall. In this paper, we are going to concentrate on an analysis of the errors in that same experiment, since patterns of errors can give us more clues as to how people are processing the language.

2. Error types

We classified the errors into a number of categories, across all conditions. The three main categories were deletion, addition, and substitution. Within both addition and substitution we further subcategorized errors according to whether they were random (in fact, very few errors were purely random), repetitions, semantic, phonological, and simultaneously semantic and phonological. I will show you examples of these error types.

A typical example of repetition could occur in the context of a stimulus sentence containing a reported item. In one such sentence, the sign DRIVE bracketed a locative phrase. Many subjects repeated some other sign in the sentence instead of DRIVE.

An example of semantic addition: That same sentence contains the abbreviation U.S. Many subjects added an A. to that. An example of semantic substitution would be the substitution of ZOOM-OFF or WALK for RUN.

Phonological errors (i.e. errors at the sublexical level) were subdivided into those errors which resulted in a real sign and those which resulted in a non-sign, though in fact for our less experienced signers this distinction was probably spurious. Examples: a stimulus like THAN elicited the response CHEAP. A stimulus like SUNDAYS elicited this response which is not an ASL sign: "BOW-DOWN" (BB down).

The category semantic/phonological included quite a few initializations such as ROOM for BOX (meaning "room"), derived forms such as FUN from FUNNY, allowable variations, such as doing a two-handed sign with one or vice versa, unpacking a classified verb as in WINDOW FLAT-THING-SHATTER, instead of simply FLAT-THING-SHATTER, or items which shared both semantic and phonological features, such as the substitution of HORSE for RABBIT.

3. Results

The results are depicted in the handout. What we found is that groups I and II pattern very similiarly in both the number of errors and in the proportion of errors in the various categories. Most of the people in group IV, signing for only a couple of years, appear quite literally to be lost, while group III, which patterns somewhat similarly to group IV, as we shall show, is doing something fundamentally different from the first two groups. We find that sentencehood has an effect on the performance of th first two groups but not the last two, and that the specific task leads to differential error patterns across the same groupings.

Let us first examine deletion errors by task. (1a) on the handout shows the mean number of errors (per subject) for memory and for shadowing. (1b) shows the mean percentage of errors per subject due to deletion. Thus, we see in (1a) that groups I and II made relatively small numbers of deletion errors, but because their total number of errors was also small, these deletion errors represent in (1b) slightly

over half of their total errors. By contrast, group IV deleted the most morphemes per subject (shown in 1a), but since they made so many other errors, these deletions constituted only about a third of their total errors.

From these figures, it is clear that memory is a more sensitive measure of the ability to process sign language efficiently than shadowing, at least at the level of the sentence.

Since so few items were deleted in shadowing, let us focus on deletion errors in memory and look at the effects of sentencehood on our subjects' performance. Number (2) on the handout presents these data. As we showed in the accuracy data, all groups show a decrement in performance for scrambled as opposed to "good" ASL sentences. However, as (2b) shows, this decrement is far greater in terms of the proportion of errors for groups I and II than for groups III and IV. This suggests that groups I and II are able to use their knowledge of ASL structure to store and access sentences. It not incidentally shows also that sign order is a cue in ASL worth paying attention to.

Let us turn now to errors of commission rather than omission. Number 3 on the handout summarizes the semantic, phonological, and semantic/phonological errors. We see from these tables that groups I and II make overall more semantic errors than phonological errors, while the situation for groups III and IV is reversed--they have more phonological than semantic errors, although, as (4) and (5) on the handout show, the semantic errors are more likely to be additions and the phonological

errors to occur in substitutions. Errors of repetition, if added to the semantic category, would serve to magnify the differences between the first and last two groups.

In the final analysis, to coin a phrase, we see in (6) and (7) the differential effect of task on error type. (6) shows semantic vs. phonological errors for shadowing. In groups I and II, we find that the task of immediate recall is more conductive to semantic than to phonological errors, while the task of shadowing leads to more phonological than semantic errors. However, for groups III and IV, there is virtually no difference in error patterns for the two task, except of course for deletion. This suggests that subjects in the groups with later ages of exposure to signing are treating the two tasks as more alike than subjects from the first two groups.

## IV. Discussion

Phonological errors can be said to reflect a shallower depth of processing than semantic errors. Lackner (1980) suggests that this superficial processing is due to time constraints. Our groups I and II are thus processing at a more superficial level for shadowing, where they make phonological errors, than for immediate recall, where they make a predominance of semantic errors, which shows that they are probably understanding rather than just parroting. Groups III and IV appear to have neither the time nor the knowledge to process at any but the most superficial level, hence the preponderance of phonological errors. We

suspect, given the puzzled expressions on the faces of many of our Group IV subjects, that, unable to attach meaning to those signs with which they are not familiar, they process both the shadowing and the memory tasks as problems in visual perception, so that in memory, when there is nothing to attach an item to, it is forgotten, while in shadowing, many signs become literally hand-waving--for example, when shadowing the sequence SNOW-FALL-ON-MOUNTAIN, many of our group IV signer did this: WHITE (LAX) HAND-WAVE.

The deletion data, coupled with the fact that they were so good at the task, shows that groups I and II are able to use structure and their knowledge of ASL to process these stimuli in an efficient manner. Recall also that when we scrambled the sentences, we left bound morphemes such as classifiers and aspectual inflections on the original signs; that is, we scrambled words rather than morphemes. Even with scrambled word order, then, these multimorphemic signs give many clues to semantic relations for people who know the structure well enough to pay attention to those cues, which our more experienced subjects did. We probably also have a ceiling effect due to the short length of many of our stimuli, but again, only for the first two groups.

The less experienced groups have a partial knowledge of ASL, and do use the structure to the best of their knowledge, but because their knowledge isn't complete enough for efficient use of the structure, they are dependent more on the perceptual level for both tasks. To put it into jargon, the first two groups can use top-down processing well, while the second two groups fail if they attempt top-down processing because there isn't enough at the top to go down.

We thus have a partial answer to the question posed at the beginning of this paper--there is indeeed a strong relation among linguistic experience, linguistic knowledge, and linguistic performance, and this relationship is not necessarily continuous. There is a clear discontinuity between groups I and II in our study. There is obviously a big difference as well in age of exposure to sign language between these two groups. We are currently testing subjects whose age of first exposure to signing was in the range of 8-10 years. We are hopeful that this group of subjects can help to answer the question as to whether there is in fact a discontinuity, and further, whether there is a critical age for exposure to signing.

Our study raises a further question, namely: is the difference between the first two groups and the last two groups due to age of exposure of years of experience? The two factors are confounded in our study, since our subjects were roughly the same age; we are going to test older subjects whose age of exposure was similar to that of our original groups but who have been signing for twenty years or more.

Differences in age of exposure or years of experience could account for our results. However, our more experienced and less experienced groups differ not only in age of exposure but also in quality of exposure, namely our more experienced subjects were surrounded with sign language in many different environments, while the less experienced subjects were often exposed to sign language only in the classroom. What happens with early but more limited exposure? Our speculation is that

for very early exposure, the quality of that exposure may not matter, but that for somewhat later exposure, it may, due to the different language-learning strategies used by older children, as well as to the sociolinguistic factors that older children are more attuned to. We shall be testing this speculation as well very soon.

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Susan D. Fischer and Rachel Mayberry

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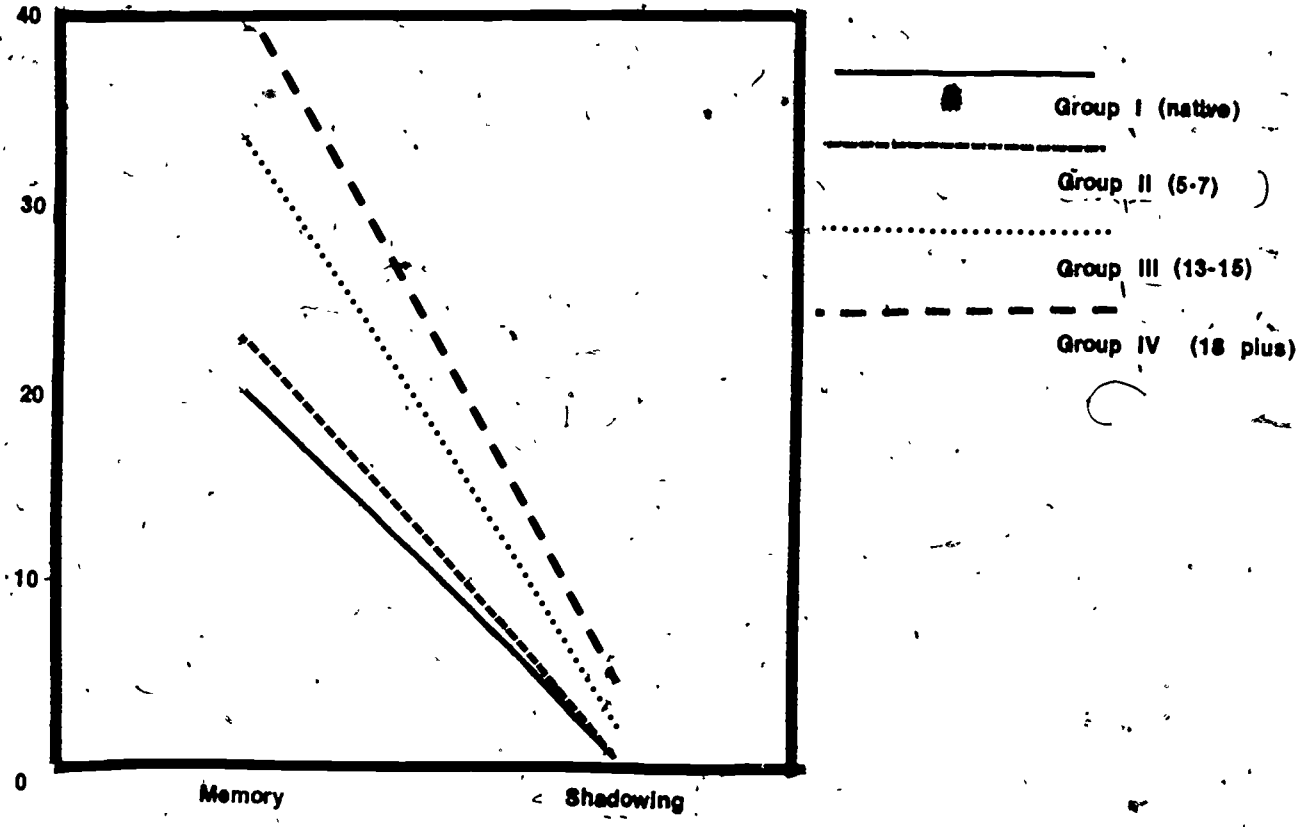
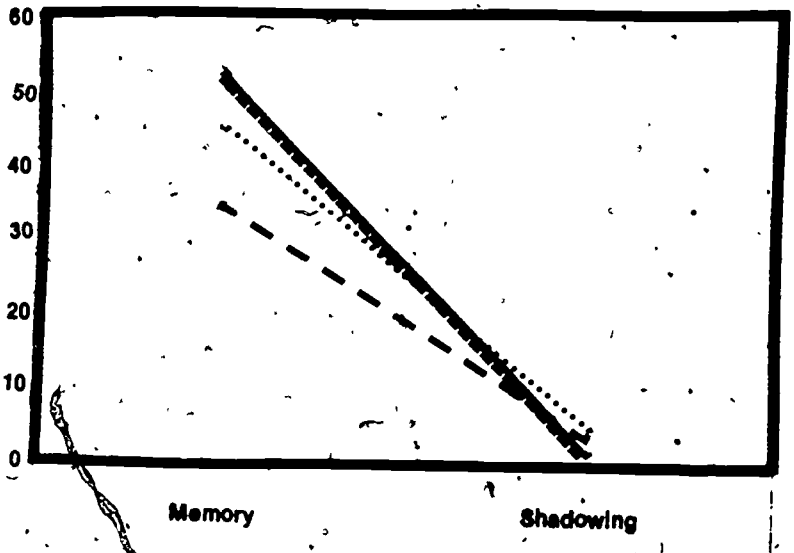
1. Deletions: Memory vs. Shadowing

a. Mean number of errors per subject

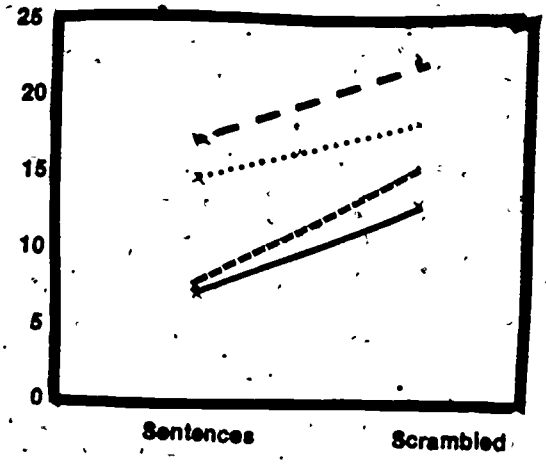



b. Mean percent of total errors per subject

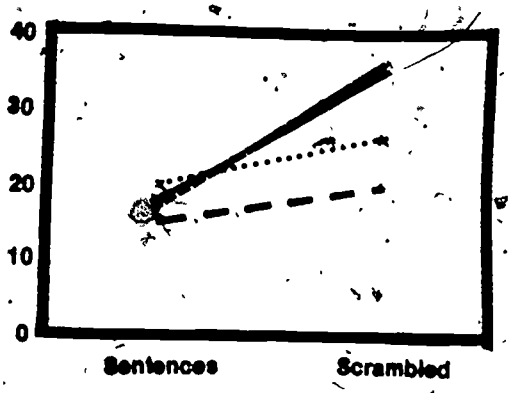


2. Deletions in memory: sentences vs. scrambled sentences

a. Mean number per subject




b. Mean percent per subject




3. Group by error type.

a. Mean number per subject

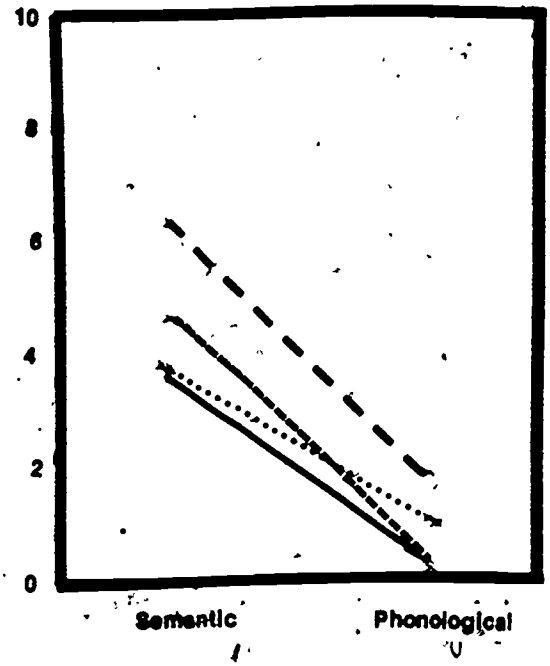
| | Semantic | Phonological | Semantic/Phonological |
|---|---|---|---|
| I | 4.80 | 2.67 | 4.42 |
| II | 6.44 | 3.89 | 4.67 |
| III | 6.66 | 16.00 | 12.92 |
| IV | 8.16 | 40.00 | 18.58 |

b. Mean percent per subject

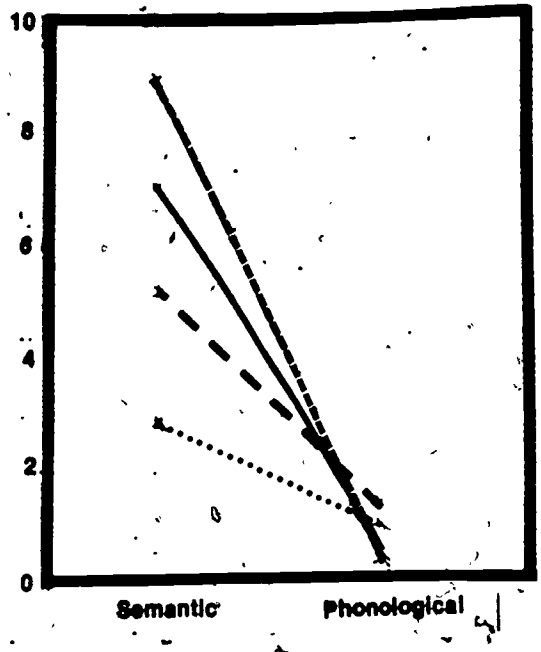
| | Semantic | Phonological | Semantic/Phonological |
|---|---|---|---|
| I | 10.73 | 6.92 | 11.43 |
| II | 13.12 | 9.68 | 10.58 |
| III | 7.84 | 20.80 | 17.29 |
| IV | 7.47 | 31.32 | 15.10 |

4. Additions by error type

a. Mean number of errors per subject

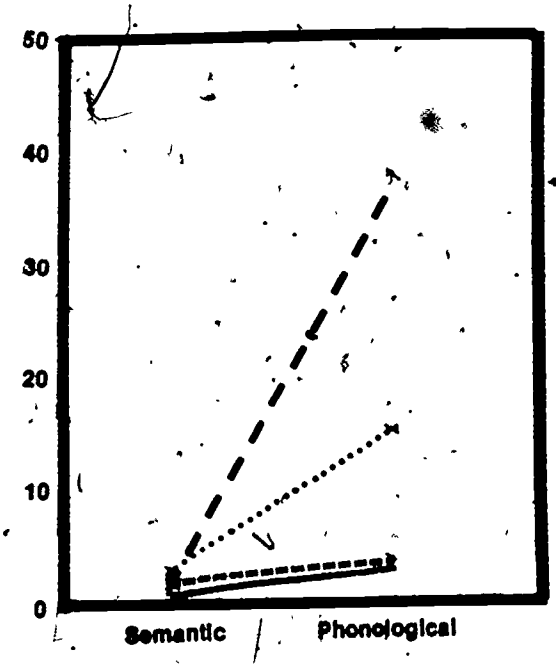



b. Mean percentage of errors per subject

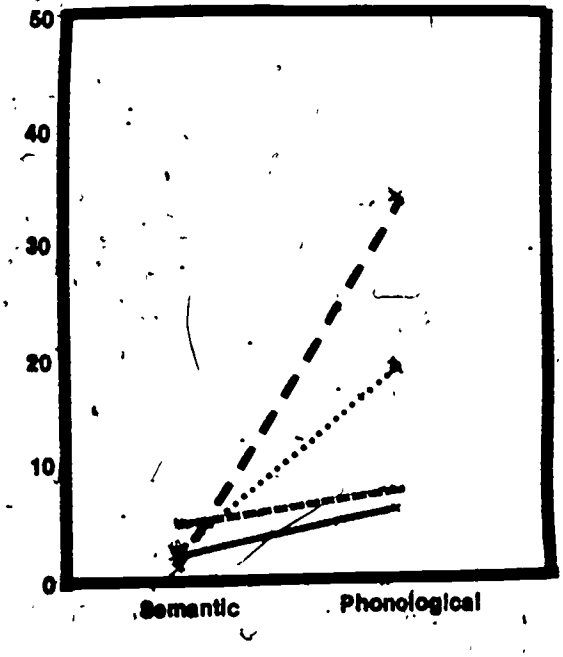



5. Substitutions by error type

a. Mean number of errors per subject

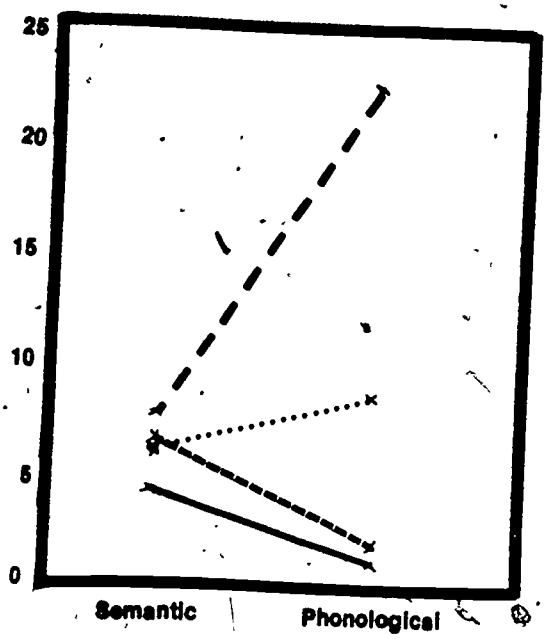



b. Mean percentage of errors per subject

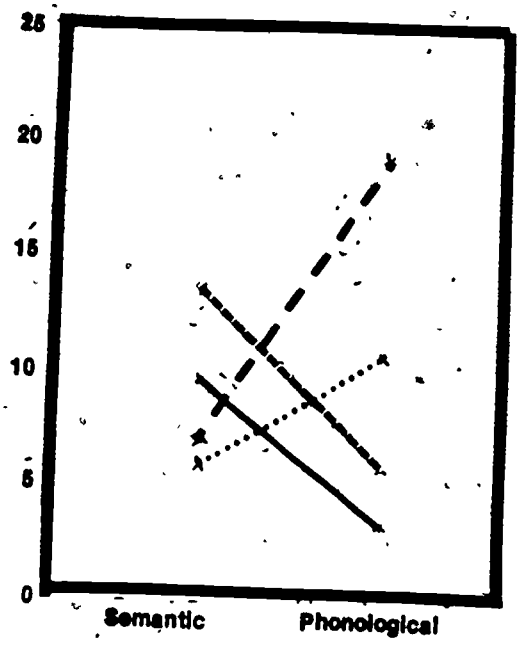


6. Memory by error type

a. Mean number of errors per subject

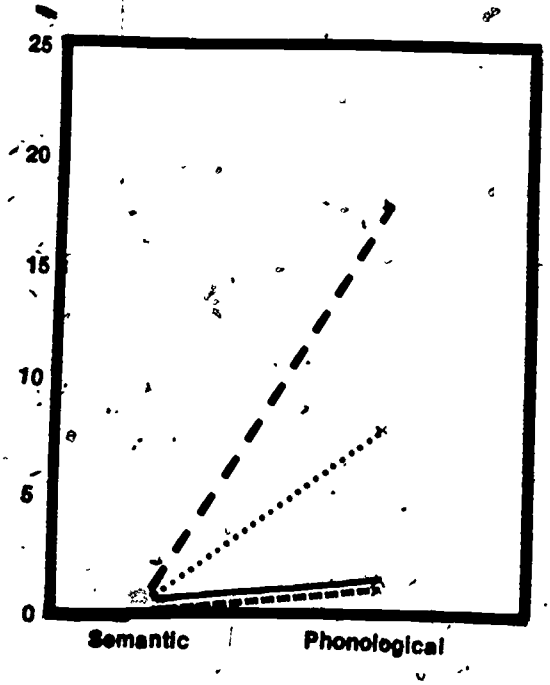



b. Mean percentage of errors per subject




7. Shadowing by error type

a. Mean number of errors per subject




b. Mean percentage of errors per subject